

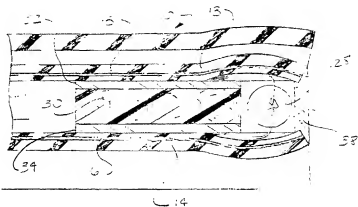
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: SAFETY EDGE SWITCH SYSTEM



## (57) Abstract

An extruded safety edge switch (10) which comprises opposing conductive rubber portions (13, 14) resiliently deformable into contact with one another to provide indicia of the presence of an obstruction evidenced by a change in electrical conductivity therethrough. The present invention includes a connector (11, 12) constructed of fiberglass having opposed laminated copper layers (32, 34, 26, 27) which may be installed between the opposed electrically conductive portions (13, 14) of the safety edge switch (10) in such a manner as to establish electrical continuity therewith. A first end of the electrical safety switch (10) will include a connector including a resistor (28) in the electrical path between copper layers (32, 34) providing a known resistive value between the opposed electrically conductive portions (13, 14). The opposing end of the safety edge switch (10) includes a connector constructed of fiberglass having laminated copper layers (26, 27) disposed on opposing portions thereof which is placed between the electrically conductive portions (13, 14) and in electrical contact therewith. The copper laminated layers (26, 27) include electrical leads (30, 31) that may be then connected to a controller (24) for monitoring electrical continuity through the safety edge switch (10). In addition, the present invention features a diagnostic technique in which the continuity of the safety edge switch (10) is verified by applying a voltage to a first electrically conductive rubber member which results in a current flowing therethrough to the opposing lead of the safety edge switch (10).

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## SAFETY EDGE SWITCH SYSTEM

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BACKGROUND OF THE INVENTIONFIELD OF THE INVENTION

This invention relates to safety edge switch systems used for detection of an obstruction encountered by a closing window and, more specifically, to a technique for providing diagnostics thereof.

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DESCRIPTION OF THE RELATED ART

Installation of safety edge switches utilized on automotive vehicles to detect the presence of an obstruction in a window opening and thereby interrupt the force supplied to close the window requires an operation to make electrical connection thereto. A typical switch utilizing conductive rubber includes a drain wire as taught by Beckhausen in U.S. Patent No. 5,023,418. Connections to drain wires requires a labor intensive stripping operation and expensive connectors. Therefore, there is a need to provide a low cost electrical connection to opposing conductive rubber portions of a safety edge switch which may be readily installed and provide a reliable environmentally safe connection. In addition, there is a need to provide a connection which will facilitate determination of electrical continuity through the entirety of the safety edge switch system.

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SUMMARY OF THE PRESENT INVENTION

The present invention includes an extruded safety edge switch which comprises opposing conductive rubber portions resiliently deformable into contact with one another to provide indicia of the presence of an obstruction evidenced by a change in electrical conductivity therethrough. The present invention includes a connector constructed of fiberglass having opposed laminated copper layers which may be installed between the opposed electrically conductive portions of the safety edge switch in such a manner as to establish electrical continuity therewith. A first end of the electrical

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safety switch will include a connector including a resistor in the electrical path between copper layers providing a known resistive value between the opposed electrically conductive portions. The opposing end of the safety edge switch includes a connector constructed of fiberglass having laminated copper layers disposed on opposing portions thereof which is placed between the electrically conductive portions and in electrical contact therewith. The copper laminated layers include electrical leads that may be then connected to a controller for monitoring electrical continuity through the safety edge switch. In addition, the present invention features a diagnostic technique in which the continuity of the safety edge switch is verified by applying a voltage to a first electrically conductive rubber member which results in a current flowing therethrough to the opposing lead of the safety edge switch.

These and other aspects of the present invention will become more readily apparent by reference to the following detailed description of the embodiments as shown in the drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an illustration of the safety edge switch system of the present invention;  
Figure 2 is a side view of a connector installed in a safety edge switch;  
Figure 3 is a plan view of a connector of the present invention;  
Figure 4 is a side view of a connector installed in a safety edge switch;  
Figure 5 is a plan view of a connector of the present invention;  
Figure 6 is a cross section of the safety edge switch used with the present invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment of the present invention, as shown in Figure 1, includes a window safety edge switch 10 including a connector 11 for establishing electrical connection thereto. A similar connector 12 may be used at the opposing end of window safety edge switch 10 to provide continuity between independent switch portions. In the preferred

embodiment of the present invention, the window safety edge switch is that shown in Figure 6 and described in my copending application entitled "Safety Edge Switch for Detection of Obstructions Encountered By A Moving Object" filed on coincident date of this case. Safety edge switch 10 includes two

5 resiliently opposed portions 13, 14 of conductive elastomeric material which may be brought into contact with one another upon a displacement for example occurring due to an obstruction encountered during closure of a window in an automotive vehicle. Stranded copper drain wires 15, 16 incorporated in the conductive rubber portions 13, 14 assure reliable low

10 resistance switching along the length thereof. In manufacturing such a safety edge switch, the most efficient operation is accomplished by extrusion; preferably coincident extrusion of materials as well as the stranded copper wires. During assembly of a system incorporating such a safety edge switch, electrical connections must be made thereto. As illustrated in Figure 1, the

15 safety edge switch will preferably be secured to the uppermost region 20 of door 22. At a first end, the stranded copper drain wires are connected to motor 23 and controller 24 via connector leads 26, 28. At the opposing end of safety edge switch 10, copper drain wires 15, 16 must be connected to one another. As in the preferred embodiment of the present invention a 5K

20 resistance plug is incorporated in the circuit path. Connectors 11, 12 used to provide these electrical connections are shown in Figures 2 and 3, including a rectangular section of fiberglass substrate 30 having a thin layer of copper laminated to opposing surfaces thereof, 32, 34. The opposing copper layers 32, 34 are electrically connected through resistor 28 via leads

25 secured to opposing copper layers 32, 34. The connector 11 may include a plurality of sawtooth cutouts 36 formed on opposing lateral portions thereof. Connector 11 may be installed in safety edge switch 10 in a manner which causes elastic deformation thereof maintaining a compression-like seal which includes environmental barrier formed by sealant 38. Such provides

30 continuity in stranded copper drain wires 15, 16 through opposing conductive rubber portions of safety edge switch 10. A similar plug 12, as shown in Figures 4 and 5, having fiberglass substrate 25 disposed between copper

layers 26, 27 with leads 30, 31 connected to opposing copper layers 26, 27 may be utilized to establish electrical continuity with stranded copper drain wires 15, 16 of opposing conductive rubber portions 13, 14 of safety edge switch 10. Plug 12 may also include sawtooth cutouts 32 on opposing lateral portions thereof, as well as notches 38, 39 which function to provide additional securance of leads 30, 31 and strain relief therefor. Plug 12 may be installed in safety edge switch 10 by elastic deformation thereof providing a compression seal and assuring the maintenance of contact between elastomeric portions thereof. In operation, the continuity of the safety edge switch 10 may be tested preferably upon each command to move a window in a closing mode, by application of a sampling voltage to a drain wire of the safety edge switch 10. An initial voltage applied to a drain wire of safety edge switch 10 through an output of motor controller 24 will verify continuity through safety edge switch 10 if the voltage results in a current comparable to a reference value. Such a comparison is performed by motor controller 24 sampling the opposing drain wire. Having passed this continuity check, motor controller 24 may supply power to a motor effecting the respective window position command.

One skilled in the art will readily recognize that certain specific details shown in the foregoing specification and drawings are exemplary in nature and subject to modification without departing from the teachings of the disclosure. Various modifications of the invention discussed in the foregoing description will become apparent to those skilled in the art. All such variations that basically rely on the teachings through which the invention has advanced the art are properly considered within the spirit and scope of the invention.

## I Claim:

1. A termination connector for a safety edge switch which includes first and second conductive rubber portions disposed in resiliently opposed portions of a generally tubular member defining an aperture therein comprising:
- 5 a nonconductive member defining first and second opposed portions;
- conductive surfaces disposed on said first and second portions;
- 10 said first and second portions maintained in electrical connection through a resistance of known value;
- said connector having dimensional properties which establish deformation of said tubular member providing electrical connection to said first and second conductive rubber portions upon installation in said aperture; and
- 15 said nonconductive member including a means for providing increased securance of said nonconductive member in said tubular member.
- 20 2. The invention of claim 1 wherein said nonconductive member is fiberglass.
- 25 3. The invention of claim 1 wherein the means for increased severance of said nonconductive member comprises laterally opposed indentations.
4. The invention of claim 1 wherein said conductive surfaces are copper.
- 30 5. The invention of claim 1 wherein said connector is sealed by a sealant.

6. The invention of claim 1 wherein said resistance is a discrete resistor disposed in a notch formed in said nonconductive member.

7. The invention of claim 1 wherein said resistance is a 5K ohm resistor.

8. An input connector for a safety edge switch which includes first and second conductive rubber portions disposed on resiliently opposed portions of a generally tubular member defining an aperture therein, comprising:

a nonconductive member defining first and second opposed portions;

conductive surfaces disposed on said first and second portions;

said first and second portions connected to first and second wires;

said connector having dimensional properties which establish deformation of said tubular member providing electrical connection to said first and second conductive rubber portions upon installation in said aperture; and

said nonconductive member including laterally opposed indentations providing increased secureance of said nonconductive member in said tubular member.

9. The invention of claim 7 wherein said nonconductive member is fiberglass.

10. The invention of claim 7 wherein said conductive surfaces are copper.

11. The invention of claim 7 wherein said first and second wires are soldered to respective first and second portions.



12. The invention of claim 7 wherein said first and second wires pass through laterally disposed notches in said nonconductive member to provide strain relief therefore.

13. A safety edge switch system including first and second conductive rubber portions disposed in resiliently opposed portions of a generally tubular member defining an aperture therein having a first end connected to a motor controller using an input connector and a second end connected by use of a termination connector, said input connector comprising:
- 5 a first nonconductive member defining first and second opposed portions;
- 10 conductive surfaces disposed on said first and second portions;
- said first and second portions maintained in electrical connection through a resistance of known value;
- 15 said connector having dimensional properties which establish deformation of said tubular member providing electrical connection to said first and second conductive rubber portions upon installation in said aperture; and
- 20 said nonconductive member including a plurality of laterally opposed indentations providing increased securance of said nonconductive member in said tubular member;
- said termination connector comprising:
- 25 a second nonconductive member defining third and fourth opposed portions;
- 30 conductive surfaces disposed on said third and fourth portions;
- said third and fourth portions connected to first and second wires;

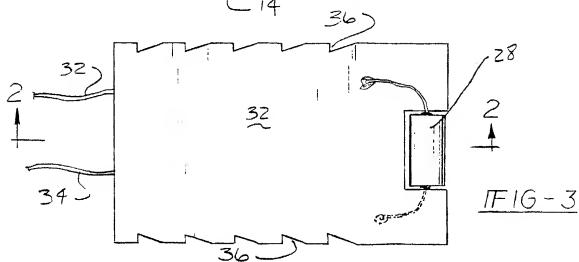
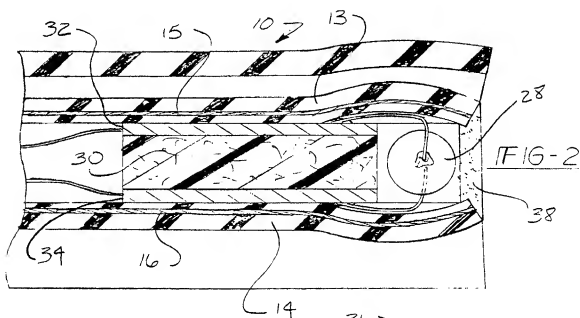
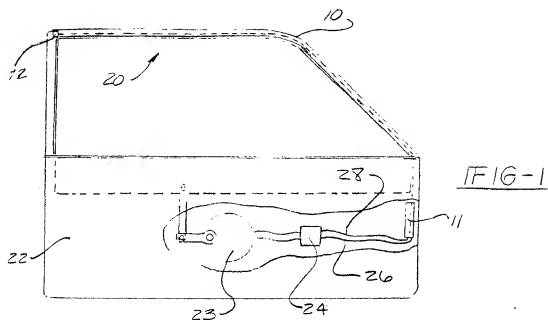
said connector having dimensional properties which establish deformation of said tubular member providing electrical connection of said third and fourth opposed portions to said first and second conductive rubber portions upon installation in said aperture; and

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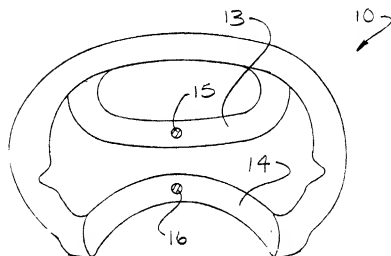
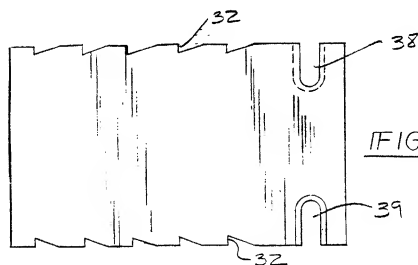
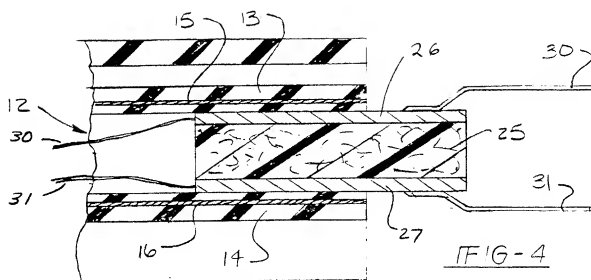
said nonconductive member including laterally opposed indentations providing increased securance of said nonconductive member in said tubular member.

14. The invention of claim 12 wherein said first and second nonconductive members are fiberglass.
15. The invention of claim 12 wherein said conductive surfaces are copper.
16. The invention of claim 12 wherein said connector is sealed by a sealant.
17. The invention of claim 12 wherein said resistance is a discrete resistor disposed in a notch formed in said nonconductive member.
18. The invention of claim 12 wherein said resistance is a 5K ohm resistor.
19. The invention of claim 12 wherein said first and second wires are soldered to respective first and second portions.
20. The invention of claim 12 wherein said first and second wires pass through laterally disposed notches in said nonconductive member to provide strain relief therefore.
21. The invention of claim 12 wherein continuity of said system may be verified by applying a known voltage to a first wire and comparing current on said second wire to a reference.

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- 2 / 2 -



## INTERNATIONAL SEARCH REPORT

 Application No  
 CT/US 93/09007

 A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 5 E05F15/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 5 E05F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	EP,A,0 383 671 (JAEGER) 22 August 1990 see column 3, line 10 - line 58  see column 4, line 25 - line 43; figures 1,2 ---	8,11 1-5,9, 10,13-16
A	EP,A,0 015 393 (ERWIN SICK) 17 September 1980  see page 8, line 22 - page 9, line 3; figures 1,2,5 -----	1,6,7, 13, 17-19,21

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of mailing of the international search report

5 January 1994

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## INTERNATIONAL SEARCH REPORT

I. on patent family members

Application No  
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0383671	22-08-90	FR-A- 2643171 US-A- 5192837	17-08-90 09-03-93
EP-A-0015393	17-09-80	DE-A- 2904434 JP-A- 55108582	07-08-80 20-08-80

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